Maryland Department of
Budget & Management

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Office of Information Technology

Systems Development Life Cycle (SDLC)

Volume 1
Introduction to the SDLC

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INTRODUCTION

1.0 STRUCTURE

The SDLC Manual consists of 4 Volumes:

- Volume 1 – Contains an overview of the SDLC and how to use the manual.
- Volume 2 – Describes the phases of the SDLC and their processes and requirements.
- Volume 3 – Contains the glossary and acronyms used in the SDLC.
- Volume 4 – Contains the templates for documents cited in the SDLC. These templates are organized in alphabetical order and are designed to serve as outlines for creation of the required documentation.

The intent has been to develop a methodology that has sufficient detail to help ensure the development of successful systems without requiring so much detail as to add unnecessary cost and complexity to projects. The continuing debate over how these objectives can best be accomplished will drive development over time of a tailored SDLC methodology that is uniquely suited to Agency and State CIO requirements.

2.0 CHANGE PROCESS

This Manual has been placed under configuration control and will be modified using a formal Configuration Control Board process. This process will be developed and implemented during July and August 2002.

3.0 ENHANCEMENT AND EVOLUTION OF THE SDLC

As the first issuance of the SDLC, this version, 1.0, will need to evolve to meet the unique requirements of the Maryland State Agencies. For example, many of the reviewers of the draft SDLC suggested that all systems might not require the rigor and the number of documents required by the methodology. Additionally, we want to make sure that changes to the documentation requirements don't invalidate documents developed under previous versions. To accommodate the needs of the Agencies, OIT intends to establish an SDLC Steering Team to address improvements, enhancements, and changes to the SDLC. These changes will be presented to the Configuration Control Board for approval before incorporation.

OIT has set a target date of December 2002 for issuance of Version 2.0 of the SDLC methodology.

OVERVIEW

1.0 BACKGROUND

The State of Maryland spends hundreds of millions of dollars each year on the acquisition, design, development, implementation, and maintenance of systems vital to mission programs and administrative functions. The need to plan for and develop safe, secure, and reliable system solutions is heightened by an increasing dependence on technology to provide services, develop products, administer programs, and perform management functions. There is also a need to ensure privacy and security when developing information systems, to establish uniform privacy and protection practices, and to develop acceptable implementation strategies for these practices.

The System Development Life Cycle (SDLC) methodology is designed to satisfy these needs by establishing procedures, and practices governing the initiation, definition, design, development, deployment, operation, maintenance, enhancement, and eventual retirement of automated information systems in the State of Maryland. **This SDLC methodology shall be used for all Major Information Technology Development Projects** which have been defined in legislation as meeting one or more of the following criteria:

(1) The estimated total cost of development equals or exceeds $1 million;
(2) *The project is undertaken to support a critical business function associated with the public health, education, safety, or financial well-being of the citizens of Maryland; or*
(3) *The Secretary (of Budget and Management) determines that the project requires the special attention and consideration given to a major information technology development project.*

For systems not designated as Major Information Technology Development Projects, Agencies are strongly encouraged to tailor and use the planning, requirements analysis, design, development, and testing documentation tools provided by the SDLC to support sound project management practices.

2.0 PURPOSE

The purpose of a Systems Development Life Cycle methodology is to provide IT Project Managers with the tools to help ensure successful implementation of systems that satisfy Agency strategic and business objectives. The documentation provides a mechanism to ensure that executive leadership, functional managers and users *sign-off* on the requirements and implementation of the system. The process provides Agency managers and the Project Manager with the visibility of design, development, and implementation status needed to ensure delivery on-time and within budget. According to General Accounting Office (GAO), Office of Management and Budget, and public and private project management publications, only 27% of systems satisfy the required business objectives. Maryland taxpayers require better performance for the State and the SDLC methodology is one of the tools that can enable IT managers to successfully deliver quality systems.

3.0 GOALS

The goals of this SDLC approach are to:

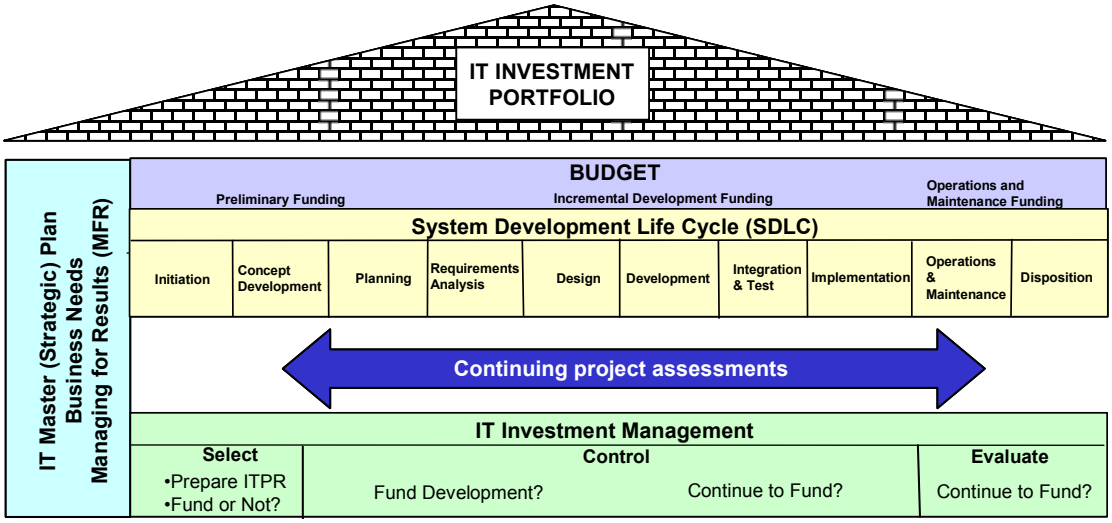
- Deliver quality systems which meet or exceed customer expectations when promised and within cost estimates.
- Provide a framework for developing quality systems using an identifiable, measurable, and repeatable process.
- Establish a project management structure to ensure that each system development project is effectively managed throughout its life cycle.
- Identify and assign the roles and responsibilities of all involved parties, including functional and technical managers, throughout the system development life cycle.
- Ensure that system development requirements are well defined and subsequently satisfied.

4.0 OBJECTIVES

The Systems Development Life Cycle methodology will help to achieve these goals by:

- Establishing appropriate levels of management authority to provide timely direction, coordination, control, review, and approval of the system development project.
- Ensuring project management accountability.
- Documenting requirements and maintaining trace ability of those requirements throughout the development and implementation process.
- Ensuring that projects are developed within the current and planned information technology infrastructure.
- Identifying project risks early and manage them before they become problems.

5.0 RELATIONSHIP OF STRATEGIC PLANNING, MANAGING FOR RESULTS AND THE IT INVESTMENT REVIEW PROCESS (ITIM) TO THE SDLC



As shown in the illustration above, the SDLC is driven by the strategic plan, performance measures, and business needs of the organization. The SDLC is interwoven with the IT Investment Management, project oversight and the budget processes to provide the IT Project Manager with all the tools needed to develop and implement systems on – time and within budget that satisfy the business needs of the functional managers and the user community.

While strategic planning is not part of the SDLC (System Development Life Cycle), all projects should clearly support the business objectives defined in the State IT Master (Strategic) Plan, the Agency IT Master Plan, and the Agency's Managing For Results (MFR) mission and goals.

The MFR process, established in FY1998, requires State agencies 'to clearly articulate their visions, missions, goals, and objectives; and ultimately to assess the success of programs through the use of performance measures' (*Maryland Managing for Results Guidebook*, Executive Summary, page i). 'The budget submission has become a vehicle for transmitting Managing for Results information to Executive and Legislative Branch decision-makers' (*State of Maryland, Fiscal Year 2003 Operating Budget Instructions*, page 11). Therefore, directly linked to the State budget process and decision-making, the MFR process sets the framework for measuring progress and ensuring accountability to the public.

The Investment Management Process utilizes the SDLC to help guide the Agency and relate the Investment Management Process with the activities of the project. The ITIM process uses the "Select-Control-Evaluate" methodology. This methodology prescribes how the State determines:

- Which information technology projects to fund (select)
- How to ensure the successful development of the application or system (control)
- How to ensure the system continues to meet mission needs (evaluate).

The ITIM process implements the goals of the State through the State's IT Master Plan, Agency IT Master Plans and linkages to Agency MFR plans.

6.0 ROLES AND RESPONSIBILITIES

The successful development, implementation, and operation of systems requires close coordination and partnership between the Agency Executive Program Sponsor, the Agency Chief Information Officer (CIO), and the State CIO. Teamwork is essential for delivery of a quality system on time and within budget. The Program Sponsor identifies the priorities and the business needs. The Agency CIO determines how best to employ technology. The State CIO approves the funding for the project and provides project oversight and guidance. These roles are described in more detail below.

6.1 Executive Program Sponsor

The Program Sponsor is responsible for providing the overall business direction for the project. The Sponsor defines and validates functional requirements, makes resources available to support information technology program initiatives, and reviews the progress of IT projects to assure that the functional requirements are being satisfied in a timely and cost-effective manner. Program Sponsors, within their area of responsibility, ensure the goals and objectives of all IT-related initiatives are consistent with and linked to MFR, and exercise management oversight of IT projects to ensure that business requirements are being satisfied in a cost-effective manner. The Sponsor assigns Program Project Managers to oversee development efforts and to oversee the maintenance and modifications of operational systems.

6.2 Agency Chief Information Officer

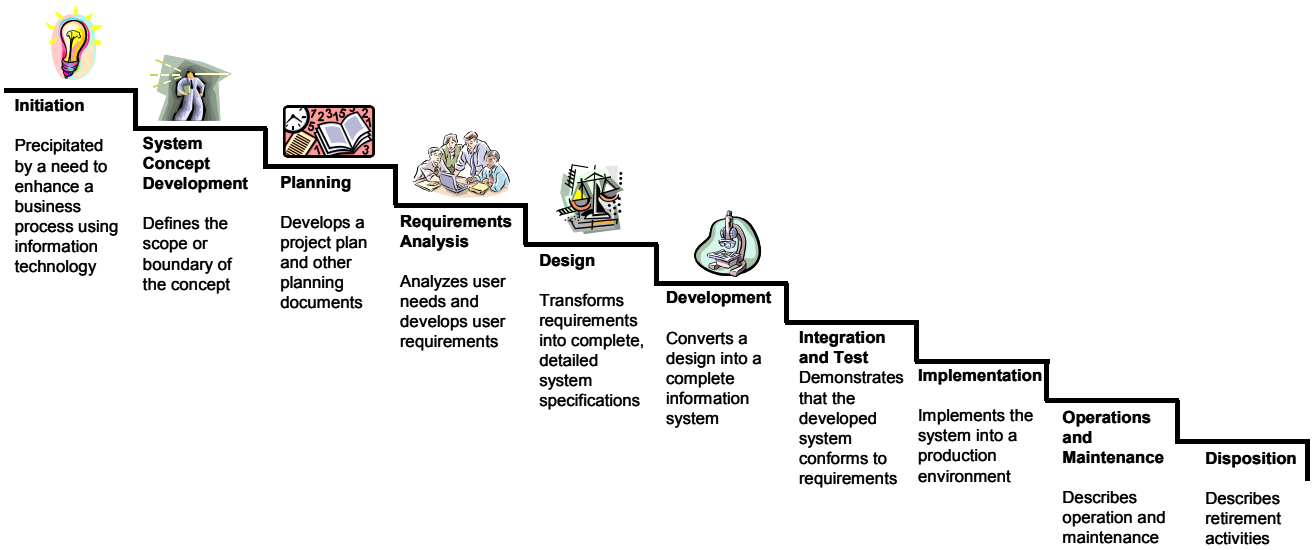
The Agency CIO is the principal advisor on the effective application of information technology to business needs and will ensure that all information technology initiatives are managed in accordance with sound life cycle management principles and practices, are consistent with the Agency IT Master Plan, and establish and administer a project management control system to provide visibility into the actual progress of each IT project.

6.3 State Chief Information Officer

The State CIO is responsible for implementation of the IT Investment Management Select-Control-Evaluate processes. In the Select phase, the State CIO reviews and approves, Information Technology Project Requests (ITPRs) and ensures that appropriate SDLC documents are in place to support the selection process. In the Control phase, the State CIO ensures that periodic project assessments are performed at major milestones to support continuing funding decisions. In the Evaluate phase, the State CIO, the Agency Program Sponsor, and the Agency CIO jointly assess the system to confirm that it satisfies Agency business needs after deployment.

7.0 THE SDLC PHASES

The State of Maryland SDLC includes ten phases, during which defined work products and documents are created, reviewed, refined, and approved. The final phase occurs when the system is disposed of and the business need is either eliminated or transferred to other systems. The tasks and work products for each phase are described in detail in the SDLC Manual. Not every project will require that the phases be subsequently executed. The SDLC may be tailored within an agency to accommodate the unique aspects of a project as long as the resulting approach remains consistent with the primary objective to deliver a quality system. SDLC phases may overlap and projects can follow an evolutionary development strategy that provides for incremental delivery of products and/or subsystems. The ten SDLC phases are illustrated below. These phases are described in more detail in the following paragraphs.



Initiation Phase

The Initiation Phase begins when a business sponsor identifies a need or an opportunity. The purpose of the Initiation Phase is to:

- Identify and define an opportunity to improve business operations for the organization.
- Identify significant assumptions and constraints on solutions to that need.
- Recommend the exploration of alternative concepts and methods to satisfy the need including questioning the need for technology, i.e., will a change in the business process offer a solution?
- Assure executive business and executive technical sponsorship.

The Sponsor designates a Project Manager and the business need is documented in a Concept Proposal. The Concept Proposal includes information about the business process and the relationship to the Agency/Organization Infrastructure and the Strategic Plan. A successful Concept Proposal results in a Project Management Charter which outlines the authority of the Project Manager to begin the project.

Initiation Phase Products	Approved By
Concept Proposal	Agency Program Sponsor Agency CIO
Project Management Charter	Agency Program Sponsor Agency CIO

System Concept Development Phase

The System Concept Development Phase begins after a business need or opportunity is validated by the Agency/Organization Program Leadership and the Agency/Organization CIO. The purpose of the System Concept Development Phase is to:

- Determine the feasibility and appropriateness of the alternatives.
- Identify system interfaces.
- Identify basic functional and data requirements to satisfy the business need.
- Establish system boundaries, identify goals, objectives, critical success factors, and performance measures.
- Evaluate costs and benefits of alternative approaches to satisfy the basic functional requirements
- Assess project risks

- Identify and initiate risk mitigation actions, and
- Develop high-level technical architecture, process models, data models, and a concept of operations.

This phase explores potential technical solutions within the context of the business need. It may include several trade-off decisions such as the decision to use COTS software products as opposed to developing custom software or reusing software components, or the decision to use an incremental delivery versus a complete, one-time deployment. Construction of executable prototypes is encouraged to evaluate technology to support the business process.

The System Boundary Document serves as an important reference document to support the Information Technology Project Request (ITPR) process. The ITPR must be approved by the State CIO before the project can move forward.

System Concept Development Phase Products	Approved By
ITPR	Agency Program Sponsor Agency CIO State CIO
System Boundary Document	Agency Program Sponsor Agency CFO Agency CIO
Risk Management Plan	Agency Program Sponsor Agency CIO

Planning Phase

During this phase, a plan is developed that documents the approach to be used and includes a discussion of methods, tools, tasks, resources, project schedules, and user input. Personnel assignments, costs, project schedule, and target dates are established. A Project Management Plan is created with components related to acquisition planning, configuration management planning, quality assurance planning, concept of operations, system security, verification and validation, and systems engineering management planning.

Planning Phase Documents	Review and Comment	Approved By
Project Management Plan	OIT ITIM	Agency Program Sponsor Agency CIO

Requirements Analysis Phase

This phase formally defines the detailed functional user requirements using high-level requirements identified in the Initiation, System Concept, and Planning phases. It also delineates the requirements in terms of data, system performance, security, and maintainability requirements for the system. The requirements are defined in this phase to a level of detail sufficient for systems design to proceed. They need to be measurable, testable, and relate to the business need or opportunity identified in the Initiation Phase. The requirements that will be used to determine acceptance of the system are captured in the Test and Evaluation Master Plan.

The purposes of this phase are to:

- Further define and refine the functional and data requirements and document them in the Requirements Document.
- Complete business process reengineering of the functions to be supported, e.g., verify what information drives the business process, what information is generated, who generates it, where does the information go, and who processes it.
- Develop detailed data and process models including system inputs and outputs.
- Develop the test and evaluation requirements that will be used to determine acceptable system performance.

Requirements Analysis Phase Products	Review and Comment	Approved By
Requirements Document	OIT ITIM	Agency Program Sponsor Agency CIO
Test and Evaluation Master Plan	OIT ITIM	Agency Program Sponsor Agency CIO

Design Phase

During this phase, the system is designed to satisfy the functional requirements identified in the previous phase. Since problems in the design phase can be very expensive to solve in later stages of the software development, a variety of elements are considered in the design to mitigate risk. These include:

- Identifying potential risks and defining mitigating design features.

- Performing a security risk assessment.
- Developing a conversion plan to migrate current data to the new system.
- Determining the operating environment.
- Defining major subsystems and their inputs and outputs.
- Allocating processes to resources.
- Preparing detailed logic specifications for each software module.

Design Phase Products	Review and Comment	Approved By
System Design Document	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Security Risk Assessment	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Contingency Plan	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO

The System Design Document receives a rigorous review by Agency technical and functional representatives to ensure that it satisfies the business requirements. It progress through a series of Design Reviews involving the Agency CIO and Business Sponsor. Once these individuals approve the design, the final System Design Document is created to serve as the Detailed Design for the system.

Concurrent with the development of the system design, the Agency Project Manager begins development of the Implementation Plan, Operations and Maintenance Manual, Training Plan, and User Manual.

Development Phase

Effective completion of the previous stages is a key factor in the success of the Development phase. The Development phase consists of:

- Translating the detailed requirements and design into system components.
- Testing individual elements (units) for usability.
- Preparing for integration and testing of the IT system.

Within this phase, the detailed specifications produced during the design phase are translated into hardware, communications, and executable software. The Project Manager develops

contingency and integration plans. Software shall be unit tested, integrated, and retested in a systematic manner. Hardware is assembled and tested. User involvement during development is an important factor in ensuring that the system is being developed according to the requirements. User testing is performed to ensure the system satisfies requirements.

Development Phase Products	Reviewed and Comment	Approved By
Software Development Document	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
System Software	Agency technical and functional staff	Agency Program Sponsor Agency CIO
Test Files/Data	Agency technical and functional staff	Agency Program Sponsor Agency CIO
Integration Document	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Test Analysis Report	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Conversion Plan (complete)	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Implementation Plan (complete)	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Operations and Maintenance Manuals (complete)	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
System Administration Manual (complete)	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Training Plan (complete)	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
User Manual (complete)	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO

Integration and Test Phase

Subsystem integration, system, security, and user acceptance testing is conducted during the integration and test phase. The user, with those responsible for quality assurance, validates that the functional requirements, as defined in the functional requirements document, are satisfied by the developed or modified system. OIT Security staff assess the system security and issue a security certification and accreditation prior to installation/implementation. Multiple levels of testing are performed, including:

- Testing at the development facility by the contractor and possibly supported by end users
- Testing as a deployed system with end users working together with contract personnel
- Operational testing by the end user alone performing all functions.

Requirements are traced throughout testing, a final Independent Verification & Validation evaluation is performed and all documentation is reviewed and accepted prior to acceptance of the system.

Integration and Test Phase Documents	Review and Comment	Approved By
Test Analysis Approval Determination	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Test Problem Reports	Agency technical and functional staff	Agency Program Sponsor Agency CIO
IT Systems Security Certification & Accreditation	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO

Implementation Phase

This phase is initiated after the system has been tested and accepted by the user. In this phase, the system is installed to support the intended business functions. System performance is compared to performance objectives established during the planning phase. Implementation includes user notification, user training, installation of hardware, installation of software onto production computers, and integration of the system into daily work processes.

This phase continues until the system is operating in production in accordance with the defined user requirements.

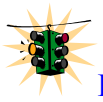
Implementation Phase Documents	Review and Comment	Approved By
Delivered System Documentation	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Change Implementation Notice	Agency technical and functional staff	Agency Program Sponsor Agency CIO
Version Description Document	Agency technical and functional staff	Agency Program Sponsor Agency CIO
Post-implementation Review Report	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO

Operations and Maintenance Phase

The system operation is ongoing. The system is monitored for continued performance in accordance with user requirements and needed system modifications are incorporated. Operations continue as long as the system can be effectively adapted to respond to the organization's needs. When modifications or changes are identified, the system may reenter the planning phase. The purpose of this phase is to:

- Operate, maintain, and enhance the system.
- Certify that the system can process sensitive information.
- Conduct periodic assessments of the system to ensure the functional requirements continue to be satisfied.
- Determine when the system needs to be modernized, replaced, or retired.

Operations and Maintenance Phase Documents	Review and Comment	Approved By
Program Trouble Reports	Agency technical and functional staff	System Manager
Change Implementation Notice	Agency technical and functional staff	System Manager Agency CIO
In-Process Review	Agency technical and functional staff	System Manager Agency CIO
User Satisfaction Review	Agency technical and functional staff	System Manager Agency CIO



Disposition Phase

Disposition activities ensure the orderly termination of the system and preserve the vital information about the system so that some or all of the information may be reactivated in the future if necessary. Particular emphasis is given to proper preservation of the data processed by the system, so that the data can be effectively migrated to another system or archived for potential future access in accordance with applicable records management regulations and policies. Each system should have an interface control document defining inputs and outputs and data exchange. Signatures should be required to verify that all dependent users and impacted systems are aware of disposition.

Disposition Phase Documents	Review and Comment	Approved By
Disposition Plan	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO
Post-termination Review Report	Agency technical and functional staff DBM OIT	Agency Program Sponsor Agency CIO

8.0 TAILORING THE SDLC TO STREAMLINE DEVELOPMENT

The SDLC may be tailored to fit the unique needs of a system, i.e., use of COTS products. Tailoring may combine life cycle phases (i.e., Initiation/System Concept, Planning/Requirements Analysis/Design, Development/Integration and Test, Implementation, Disposition), may omit, combine, or reduce tasks or work products, and may require added or different tasks or work products, as appropriate. The IT Project Manager should consider the size, complexity, and scope of the project when preparing SDLC documentation. The tailored process must include an Initiation/Concept phase which bases much of the information gathering on the approach to satisfying the business need or opportunity. There are essential tasks and work products that cannot be "tailored out" even when a COTS software product will be used:

- Clear functional requirements are needed.
- The system must be able to operate within the State's current and planned information technology infrastructure and architecture.
- A determination of the feasibility of the project and a look at possible alternatives, including continuing with the status quo.
- The system must be adequately tested.
- The users must be adequately trained.

- Operations and maintenance documentation must be completed.

The phases described in the SDLC are not intended to constrain systems development such that one phase must be completed before another phase begins. Many phases may be ongoing at one time using approaches such as Rapid Application Development (RAD). The documents described in the SDLC Manual provide a recommended order to guide those responsible for development.

9.0 SUMMARY

The ultimate goal of a Systems Development Life Cycle methodology is to provide a tool set to Project Managers to produce predictable, quality systems to satisfy user needs. This methodology will evolve over time to focus more specifically on the needs of the Agencies' and the Project Managers who are implementing systems. As this evolution occurs, the methodology will become more and more efficient in satisfying our needs for better management of better systems for the Maryland taxpayer.